Department of Civil Engineering
Vidya Academy of Science and Technology

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WHEN WE TACKLE OBSTACLES, WE FIND HIDDEN RESERVES OF COURAGE AND RESILIENCE WE DID NOT KNOW WE HAD. AND IT IS ONLY WHEN WE ARE FACED WITH FAILURE DO WE REALISE THAT THESE RESOURCES WERE ALWAYS THERE WITHIN US. WE ONLY NEED TO FIND THEM AND MOVE ON WITH OUR LIVES.

~Dr A. P. J. ABDUL KALAM

Department of Civil Engineering
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Thalakottukara P.O., Thrissur - 680501

VISION

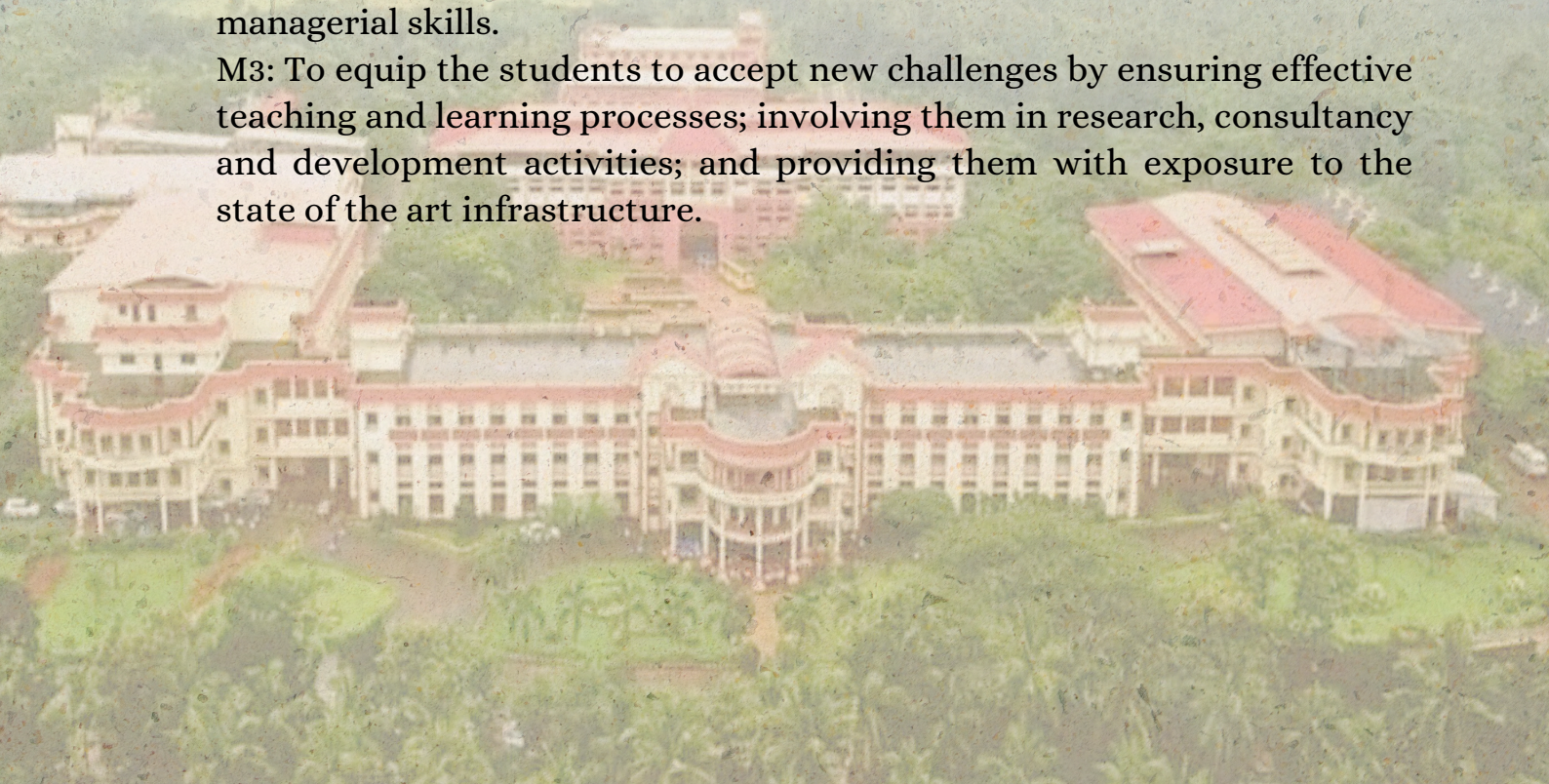
"Progress through quality education by keeping pace with new challenges in the field of Civil Engineering".

MISSION

M1: To provide an academic environment for the students for developing as capable professionals by empowering them with knowledge, skills, moral values and confidence.

M2: To prepare the students to become global leaders of tomorrow by promoting team work practices and inculcating communication and managerial skills.

M3: To equip the students to accept new challenges by ensuring effective teaching and learning processes; involving them in research, consultancy and development activities; and providing them with exposure to the state of the art infrastructure.



Dr SUNITHA C.
PRINCIPAL

PRINCIPAL'S MESSAGE

It is with immense pride that I introduce the first edition of "ENGINUITY", the technical magazine of our Civil Engineering Department. This magazine is not just a collection of articles and research papers; it is a reflection of the dedication, innovation, and technical excellence that define our Civil Engineering community.

Civil engineering stands as the foundation upon which modern society is built, shaping the infrastructure that supports every facet of our lives—from the roads we travel to the buildings we inhabit. The content within this publication—ranging from groundbreaking research to thought-provoking articles—showcases the remarkable efforts and creativity of our talented students and dedicated faculty members. Together, they are advancing this critical discipline, pushing boundaries, and finding innovative solutions to the challenges of today and tomorrow.

This magazine is a testament to the collaborative efforts of many. I extend my heartfelt appreciation to the editorial team for their meticulous work, to the contributors for sharing their valuable insights, and to everyone else who played a part in making this initiative a reality. Your collective efforts have resulted in a publication that reflects not just the technical prowess but also the ambitious vision of our Civil Engineering Department.

Let this magazine serve as a source of inspiration, a repository of knowledge, and a reminder of the impact that civil engineering has on shaping a better future. I invite you to immerse yourself in the rich content of this edition and hope that it sparks new ideas, insights, and enthusiasm for the transformative potential of this field. Together, we are not just building infrastructure; we are building a sustainable, resilient, and innovative future.

Warm regards,
Dr Sunitha C.
Principal

Dr ABHILASHA P. S.
HOD

HOD'S MESSAGE

As we usher in the academic year of 2024-2025, it is with great enthusiasm and pride that Iextend my greetings to all the readers of this esteemed technical magazine. This publication marks a significant milestone for our department, as it is the very first technical magazine released by the Civil Engineering Department of our esteemed college. It stands as a testament to the relentless pursuit of knowledge, innovation, and excellence that defines our department and its vibrant community..

The field of civil engineering is ever-evolving, driven by the need to address contemporary.challenges and create sustainable solutions for the future. At our college, we are committed to nurturing the minds that will lead this transformation. Our students, faculty, and researchers are engaged in ground breaking projects that push the boundaries of traditional engineering paradigms, embracing new technologies and methodologies to build a better tomorrow. This inaugural issue of the magazine showcases a selection of our latest research initiatives, including innovative projects on structural engineering, advancements in sustainable construction materials, and the integration of modern analytical techniques to enhance infrastructure resilience. Each article reflects the dedication and intellectual rigor of our students and faculty, highlighting their contributions to the field and their potential to impact society positively.

I am particularly proud of the strides we have made in interdisciplinary collaboration, where civil engineering intersects with environmental science, urban planning, and information technology. In addition to our academic and research achievements, I would like to highlight the success of our recent technical festival organized by the Civil Engineering Department. This event brought together students, professionals, and experts from various fields, fostering an environment of learning, networking, and innovation. The festival featured workshops, competitions, and sessions that showcased the immense talent and creativity within our community. It was a resounding success and a testament to the collaborative spirit and organizational capabilities of our department.

I extend my heartfelt thanks to the editorial team, contributors, and all those who have worked tirelessly to bring this publication to life. Let us continue to strive for excellence, embrace challenges, and work together to build a sustainable and resilient future. Thank you, and I wish you an enlightening reading experience!

Dr Abhilasha P. S.
Professor & Head of the Department
Department of Civil Engineering

GLORIA ANTO
STAFF EDITOR

STAFF EDITOR'S MESSAGE

Welcome to the first edition of "ENGINUITY", a technical magazine of the Department of Civil Engineering, where innovation meets expertise. Our magazine is a reflection of the passion, innovation, and technical prowess that define our community. In this issue, we dive deep into the latest advancements and research in civil engineering, with a special focus on sustainable construction, and infrastructure resilience. These topics are not only critical to the future of our profession but also resonate with the challenges and opportunities we face as aspiring civil engineers.

I firmly believe that the knowledge and perspectives shared within these pages will ignite curiosity, foster innovation, and inspire our readers to contribute meaningfully to the field of civil engineering. As a community, our shared responsibility goes beyond designing structures; it encompasses addressing some of the most pressing global challenges, such as climate change, urbanization, and sustainable resource management.

We are proud to feature contributions from our talented students and faculty, who bring diverse perspectives and cutting-edge knowledge to the table. From insightful research articles to practical case studies and project highlights, this issue is packed with content that we hope will inspire, educate, and challenge you.

Our regular sections on student projects, faculty research, industry trends, etc. continue to provide valuable insights and updates on the latest happenings in the world of civil engineering. As always, we encourage your feedback and active participation which will help us make "ENGINUITY" a true reflection of our collective spirit.

Thank you for your continued support. Let's build the future of civil engineering together!

Warm regards,
Gloria Anto
Staff Editor

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ARTIFICIAL INTELLIGENCE IN IRRIGATION

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ABSTRACT

Agriculture is a key player in the economy, with automation being a major focus worldwide. As the population grows, so does the demand for food and jobs. Traditional farming methods were inadequate, leading to the introduction of new automated techniques that met food needs and created job opportunities. Artificial Intelligence has revolutionized agriculture, safeguarding crop yields against climate changes, population growth, employment concerns, and food security issues. Researchers are working on implementing automated weeding systems and soil water sensing methods in agriculture. A smart irrigation system prototype can save up to 80% of water by automatically providing water to plants based on their needs. This innovative system aims to save time and prevent issues like constant monitoring. Embedded and microcontroller systems help control water systems in gardens by monitoring soil temperature and moisture to estimate plant water demands efficiently.

1. INTRODUCTION

India's traditional irrigation methods impact crop yield, varying with geographical and climatic factors. Farmers rely on personal experience, leading to inefficiency. To improve, India needs a reliable irrigation solution that adapts to local conditions, predicts water needs accurately, and promotes judicious resource use. With water wastage a major concern, the country faces droughts, erratic rainfall, and economic losses. An intelligent irrigation system has been developed in India to adapt to changing rainfall patterns and geographical variations. By analyzing soil moisture content, the system accurately predicts the amount of water needed for irrigation, minimizing wastage and maximizing crop yield. The system is highly autonomous, requiring minimal human intervention once deployed. It uses a Random Forest Regressor to predict weather patterns, gradually adapting to specific climatic conditions for improved accuracy.

The system designed is power efficient, water efficient, and low on maintenance. The systems are scattered throughout the area of the farm. Thus, we can switch on the drip or sprinkler for a particular area rather than the entire farm to increase efficiency. This helps minimize water wastage and a better understanding of crop water capacity and patterns required for efficient irrigation. Also, the nodes work on a response-based system, making identifying any malfunction easier. The health of the nodes can be monitored through a mobile app based on the mapping of the farm and the area specified for irrigation.

2. BENEFITS

- Water Conservation

AI-powered smart irrigation systems leverage advanced algorithms to monitor soil moisture levels, weather conditions, and plant requirements. This data-driven strategy helps farmers irrigate crops effectively while reducing water wastage and promoting environmental sustainability.

- Enhanced Crop Yield

The data-driven AI approach ensures that each plant is provided with optimal growing conditions. When landscapers or farmers can adjust irrigation schedules based on various factors like crop types, soil conditions, and environment, it contributes to significant crop yields.

- Improved Plant Health

AI technology can analyze multiple factors, including temperature, soil composure, sunlight exposure, and humidity, to determine the exact amount of water each plant requires. This precise irrigation lowers the risk of water stress or overhydration in plants and enhances plant growth.

- Energy Efficiency

AI-based smart irrigation systems can reduce energy consumption by applying precise amounts of water, detecting leaks, and adjusting watering schedules based on water demand and weather prediction. This leads to lower operating costs and substantial energy savings.

- Cost-effectiveness

With AI-based smart irrigation systems, growers can reduce manual labor and automate irrigation operations. Automation by smart irrigation lowers the need for human monitoring and managing irrigation and the need to apply excessive fertilizers, which leads to long-term cost savings and economic benefits.

Figure 1: AI in Irrigation

3. APPLICATION

Sprinkler Irrigation
AI technology has transformed traditional sprinkler systems into smart systems. An AI-based sprinkler irrigation system collects real-time weather data from rain sensors that measure the amount of rainfall and soil conditions to plan the next irrigation. After this data is analyzed, the system sends notifications to sprinklers to avoid overwatering or excessive water usage.

Drip Irrigation
This is the most efficient irrigation method as it delivers water directly to the plant's roots, reduces runoff, ensures even distribution, and improves irrigation efficiency. AI further enhances this method. In AI-powered drip irrigation systems, sensors are placed in the soil to monitor soil moisture levels, which helps AI algorithms precisely control the water flow.

Center Pivot Irrigation
This is a common irrigation method used in large-scale farming. In-field sensors installed on moving irrigation equipment collect data on soil and crop health. Sensors provide this information to an AI-based system that uses this data to control circle irrigation sprinklers and adjust the pivot's speed, stream, and angle of water flow.

4. SUCCESS STORY

A study was done to improve water usage efficiency in legume agriculture, specifically focusing on peas in the state of Uttar Pradesh. Artificial intelligence (AI) and precision irrigation were used to address water shortages, promote sustainable farming practices, and enhance crop yield. A systematic approach, including data collection, AI-enabled programs, and thorough data analysis, was employed to extract valuable findings.
The research found that AI-driven irrigation systems performed far better than conventional irrigation techniques in terms of cost savings, increased crop output, and water conservation. Through an in-depth investigation of the data, the research demonstrated that significant savings in water are possible using AI in precision irrigation. This is especially important in areas where water is scarce. Similarly, field wise, a unified agriculture management platform powered by AI/ML and other technologies identified over 100k hectares of fields with critical soil moisture stress, and communicated these findings weekly in the state. As a result of this initiative, a total of 4,540 farmers have reaped the benefits of optimized water management practices.

5. CHALLENGES

Small-scale farmers face challenges in adopting AI systems due to several limitations. These challenges include a lack of initial investment technical knowledge, difficulties in using mobile applications, and concerns about data privacy.

AI models must account for unpredictable weather patterns and climate change.

AI solutions must be adaptable to different crops, soil types, and irrigation systems.

·AI must optimize irrigation to balance water conservation and crop yield.

REFERENCES

1. Ai-driven irrigation planning: maximizing crop yields and water efficiency, Vassar labs [Online].
2. The Role of Artificial Intelligence (AI) in Smart Irrigation Systems, Dripworks [online], 11 Jan 2024.
3. S. Darshna, T.Sangavi , Sheena Mohan, A.Soundharya, Sukanya Desikan (2015): 'Smart Irrigation System', IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), Volume 10, Issue 3, Ver. II May - Jun.2015.
4. Savita Choudhary, Vipul Gaurav, Abhijeet Singh, Susmit Agarwal (2019): 'Autonomous Crop Irrigation System using Artificial Intelligence', IJEAT International Journal of Engineering and Advanced Technology, Volume-8, Issue-5S, May 2019.

INFLUENCE OF HUMAN PSYCHOLOGY IN CIVIL ENGINEERING

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ABSTRACT

Civil engineering, traditionally regarded as a technical field, has long dealt with the design, construction, and maintenance of infrastructure. However, in recent years, the importance of human psychology in shaping civil engineering outcomes has gained recognition. This article explores how psychological principles influence civil engineering projects, addressing the needs and behavior of the people who interact with these structures. Through understanding human behavior, perception, and decision-making, engineers can create spaces that foster well-being, safety, and productivity. This paper also examines case studies and examples that showcase the impact of psychological considerations in civil engineering projects and discusses future prospects for incorporating psychology into engineering design and practices.

1. INTRODUCTION

Civil engineering is a discipline that shapes the built environment around us, from roads to bridges, residential buildings to public spaces. Traditionally, it has been driven by structural integrity, materials science, and economic feasibility, but the role of human psychology has become increasingly relevant. Understanding the end-user's needs, emotions, and behaviors can vastly improve the success and longevity of a project. This interaction between psychology and civil engineering is evident in urban planning, building design, and traffic management.

For example, designing staircases with lower rises in hospitals accommodates individuals with mobility issues, while intuitive navigation systems reduce stress. Engineers also address perception of safety through well-lit environments and traffic calming measures, while green spaces and noise-reducing materials help lower stress. By incorporating psychological insights, civil engineers can create safer, more comfortable, and sustainable environments, making it crucial to design with human psychology in mind, especially in an era of growing urban populations and complex societal needs.

2. NEEDS AND IMPORTANCE OF INCORPORATING HUMAN PSYCHOLOGY IN CIVIL ENGINEERING

1. Enhancing User Comfort and Safety

One of the primary objectives of incorporating psychology into civil engineering is to enhance user comfort and safety. Public spaces and infrastructure should evoke a sense of security and well-being. Factors such as lighting, colors, acoustics, and spatial design can significantly influence how people feel and behave in a space. For instance, a well-lit walkway in a park or a traffic roundabout designed for better visual perception can reduce anxiety and promote positive behaviors such as adherence to traffic rules.

2. Improving Traffic Flow and Safety

Human psychology plays a crucial role in traffic management. Engineers must consider how drivers perceive road signs, intersections, and speed limits. Traffic designs that align with drivers' expectations and cognitive patterns are more effective in promoting road safety. For example, roundabouts and speed bumps are strategically designed to prompt cautious driving behavior. Additionally, pedestrian crossings are often placed at visually prominent locations to ensure they are easily noticed by both drivers and pedestrians.

3. Encouraging Sustainable Practices

Sustainability is a key goal in modern civil engineering projects. Psychological insights are essential for encouraging sustainable practices among the public. For instance, when public transportation systems are designed to be visually appealing, comfortable, and efficient, people are more likely to choose them over personal vehicles. Similarly, energy-efficient buildings that provide a sense of comfort and well-being can motivate occupants to adopt environmentally friendly behaviors, such as reducing energy consumption.

4. Enhancing Productivity and Well-Being in Workspaces

In civil engineering projects that involve the design of offices, schools, or industrial environments, understanding human psychology is essential for optimizing productivity and well-being. Research shows that natural lighting, open spaces, and ergonomic design can boost concentration, creativity, and overall job satisfaction. For instance, green spaces in and around buildings have been shown to reduce stress levels and enhance cognitive functioning, thereby improving overall performance.

5. Mitigating Disaster Impact

Psychological principles are also relevant in disaster management and the design of resilient infrastructure. Engineers must consider how people will react during emergencies such as earthquakes, floods, or fires. For instance, clear signage, easily navigable evacuation routes, and the strategic placement of emergency facilities can reduce panic and confusion, leading to better outcomes during a crisis. Understanding human psychology in these scenarios can save lives by promoting calm, organized behavior during emergencies.

3. EXAMPLES OF HUMAN PSYCHOLOGY IN CIVIL ENGINEERING

1. Urban Design in Copenhagen, Denmark

Copenhagen is known for its human-centered urban design, where psychological principles are integrated into the city's infrastructure. The city's cycling lanes are an example of how thoughtful design can encourage healthy behavior. Wide, clearly marked lanes with priority over vehicles make cycling a safe and appealing option for commuters. The city's public spaces are designed with comfort in mind, with ample seating, greenery, and lighting that promotes a sense of safety and community.

2. Pedestrian-Friendly Walkways in Tokyo, Japan

Tokyo's busy streets are often designed to prioritize pedestrians, with an emphasis on safety and convenience. Crosswalks are positioned in highly visible areas, and pedestrian bridges reduce the need for individuals to cross busy streets directly. These designs not only improve the flow of foot traffic but also reduce accidents, demonstrating how civil engineering can be optimized with an understanding of human psychology.

3. Restorative Hospital Design in Singapore

Singapore has integrated psychology into the design of some of its hospitals to create environments that aid healing. The Khoo Teck Puat Hospital, for instance, features large windows that allow ample natural light to enter, along with green spaces and water features. These elements reduce stress for patients and staff, fostering a calming atmosphere conducive to recovery.

4. CASE STUDY: THE HIGH LINE, NEW YORK CITY

The High Line in New York City is a notable case study that demonstrates the positive impact of integrating human psychology into civil engineering. Initially an abandoned railway line, it was transformed into an elevated public park that attracts millions of visitors annually. The design of the High Line emphasizes human interaction with nature and urban space. Pathways are lined with trees, plants, and art installations that stimulate the senses, creating a relaxing and engaging environment in the middle of a bustling city.

Figure 1: The High Line, NewYork City

What makes the High Line successful is its ability to meet psychological needs for community interaction, relaxation, and recreation. The park promotes social interaction by providing ample seating areas, walkways, and open spaces where people can gather, while the natural elements incorporated into the design foster a sense of calm and connection to the environment. This case study illustrates how civil engineering, when informed by psychological principles, can enhance the quality of urban life.

5. CONCLUSION

The influence of human psychology in civil engineering is an evolving area of interest, with far-reaching implications for the design, functionality, and sustainability of infrastructure. By acknowledging and incorporating psychological principles into civil engineering, we can create spaces that not only meet practical requirements but also promote well-being, safety, and sustainability. Whether through urban planning, traffic management, or disaster mitigation, the future of civil engineering will increasingly depend on understanding human behavior and designing accordingly.

REFERENCES

1. Gifford, R. (2014). Environmental Psychology: Principles and Practice. Optimal Books.
2. Motamedi, A. (2020). Human-centered design in civil engineering. International Journal of Civil Engineering, 18(2), 235-247.
3. Johansson, M., & Hartig, T. (2020). The restorative effects of urban environments. Landscape and Urban Planning, 203, 103878.
4. Chen, Z., & Zhang, P. (2022). Urban resilience and the role of psychology in disaster management. Journal of Civil Engineering and Management, 28(3), 157-166.
5. Loukaitou-Sideris, A., & Ehrenfeucht, R. (2023). Human Cities: Civic Engagement and the Public Realm. MIT Press.

EXOSKELETONS IN CONSTRUCTION: REVOLUTIONIZING WORKER EFFICIENCY, SAFETY, AND PRODUCTIVITY

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ABSTRACT

Exoskeletons, wearable devices designed to augment human capabilities, offer the potential to significantly improve worker safety, enhance productivity, and reduce injuries. By supporting the body and reducing physical strain, exoskeletons can help prevent musculoskeletal disorders (MSDs), a common occupational hazard in construction. This paper examines different types of exoskeletons used in construction, including upper-body, lower-body, and full-body exoskeletons. It discusses the various benefits of exoskeleton technology, such as injury prevention, increased efficiency, and reduced worker fatigue. Challenges such as cost and ergonomics are also addressed. Finally, the paper explores the future of exoskeletons in construction, including advancements in technology and the potential for increased adoption.

1. INTRODUCTION

In the dynamic and ever-evolving world of construction, ensuring worker safety and productivity is of paramount importance. The sector is notorious for its physically demanding tasks, often leading to musculoskeletal disorders (MSDs), injuries, and fatigue. However, with the advent of cutting-edge technologies, the landscape of construction is changing rapidly. One of the most promising innovations in this area is the exoskeleton—a wearable device designed to augment human capabilities and transform how construction tasks are performed.

Exoskeletons, which were initially developed for medical rehabilitation and military use, are now finding their way onto construction sites across the globe. These wearable devices, designed to support and enhance human movement, have the potential to improve worker safety, increase efficiency, and reduce injuries on construction sites. This article explores the various types of exoskeletons, their benefits, challenges, and the future of their integration into the construction industry.

Figure 1: Contruction Exoskeleton

2. UNDERSTANDING EXOSKELETONS IN CONSTRUCTION

1.1 Definition and Evolution of Exoskeletons

An exoskeleton is a wearable device that supports the wearer's body to enhance their physical abilities, either through mechanical or powered systems. The core concept of exoskeletons has been inspired by nature, particularly from insects like beetles and lobsters, which have an external skeleton to protect and support their bodies. In a similar vein, exoskeletons in construction act as an external framework that augments human capabilities, enabling workers to perform tasks with less physical strain.

Initially, exoskeletons were primarily developed for use in the medical field to assist patients with mobility issues and for soldiers to carry heavy loads. However, their application has broadened considerably over time, extending into the industrial and construction sectors. Today, exoskeletons are being designed specifically for construction workers, helping them lift heavy objects, sustain prolonged physical exertion, and reduce the risk of injury.

1.2 Types of Exoskeletons in Construction

Exoskeletons used in construction can be categorized into three primary types based on the area of the body they support:

Upper Body Exoskeletons: These devices focus on supporting the arms, shoulders, and upper back. They are particularly useful for workers engaged in overhead tasks such as painting, welding, or installing fixtures. By reducing the strain on the upper body, these exoskeletons help prevent fatigue and injury.

Lower Body Exoskeletons: These exoskeletons provide support to the legs and lower back, assisting workers in lifting and carrying heavy loads or performing tasks that involve squatting, kneeling, or standing for long periods. They are invaluable for tasks like masonry, heavy lifting, and carrying equipment across construction sites.

Full-Body Exoskeletons: Offering comprehensive support to both the upper and lower body, full-body exoskeletons are used for physically demanding tasks that require strength and endurance. These devices distribute the weight of tools or loads across the body, minimizing strain and enabling workers to perform repetitive motions without excessive fatigue.

3. BENEFITS OF EXOSKELETONS IN CONSTRUCTION

2.1 Injury Prevention and Worker Safety

One of the most significant benefits of exoskeletons in construction is their potential to reduce injuries. Construction work is physically demanding and often involves lifting heavy materials, working in awkward postures, and performing repetitive tasks. These factors contribute to a high incidence of musculoskeletal disorders (MSDs) among construction workers. According to the Occupational Safety and Health Administration (OSHA), MSDs account for a significant portion of workplace injuries in the construction industry.

Exoskeletons can play a pivotal role in mitigating these risks by reducing the strain on muscles and joints. For example, a worker using an upper-body exoskeleton to hold a tool overhead can do so for longer periods without experiencing shoulder or arm fatigue. Similarly, lower-body exoskeletons can assist workers in lifting heavy loads by redistributing the weight more evenly across the body, reducing the risk of back injuries.

2.2 Enhanced Productivity and Efficiency

In addition to improving worker safety, exoskeletons can also significantly boost productivity. By augmenting human strength and endurance, these devices enable workers to perform physically demanding tasks more efficiently and for longer durations. This means that workers can maintain high levels of performance throughout the day without becoming fatigued, leading to faster completion of tasks.

For instance, tasks that involve repetitive overhead work, such as installing drywall or painting ceilings, can be completed more quickly and with greater precision when workers use exoskeletons. This increased efficiency can result in substantial time savings on construction projects, allowing for faster project completion and reduced labor costs.

2.3 Reduction of Worker Fatigue

Construction work often involves repetitive motions, awkward postures, and heavy lifting, all of which can lead to fatigue over time. Exoskeletons are designed to reduce the physical effort required to perform these tasks, helping workers conserve energy and reduce fatigue. This is particularly beneficial for older workers or those with preexisting health conditions, as exoskeletons can enable them to continue working without the risk of overexertion.

By reducing fatigue, exoskeletons can also help prevent accidents on construction sites. Fatigue is a common cause of accidents, as tired workers are more prone to mistakes and lapses in concentration. With exoskeletons providing physical support, workers can remain alert and focused, reducing the likelihood of accidents and injuries.

4. CHALLENGES IN THE ADOPTION OF EXOSKELETONS

3.1 Cost of Exoskeletons

Despite the numerous benefits, one of the primary challenges facing the widespread adoption of exoskeletons in construction is their cost. Exoskeletons, particularly the more advanced powered models, can be expensive, with prices ranging from several thousand to tens of thousands of dollars per unit. For small construction firms with limited budgets, this cost may be prohibitive.

However, as technology advances and economies of scale come into play, the cost of exoskeletons is expected to decrease. Additionally, the long-term savings resulting from reduced injury-related costs and increased productivity may outweigh the initial investment, making exoskeletons a cost-effective solution for many construction companies.

3.2 Ergonomics and Fit

Another challenge associated with exoskeletons is ensuring that they are ergonomically designed and properly fitted to individual workers. If an exoskeleton does not fit well, it may cause discomfort, reduce efficiency, or even increase the risk of injury. Therefore, manufacturers must prioritize creating adjustable, customizable designs that accommodate a wide range of body types and sizes.

Training is also essential to ensure that workers can use exoskeletons effectively. Proper training ensures that workers understand how to operate the device correctly, avoid accidents, and maximize the benefits of the technology.

5. CASE STUDIES OF EXOSKELETON USE IN CONSTRUCTION

Several construction firms around the world have begun adopting exoskeleton technology with promising results. For example, Boeing has integrated exoskeletons into its construction and assembly processes to reduce worker fatigue and injury. Workers using upper-body exoskeletons reported a significant reduction in shoulder and arm strain while performing overhead tasks.

Another case involves Ford Motor Company, which implemented exoskeletons in its manufacturing facilities to assist workers with repetitive overhead work. The company reported a significant reduction in injuries and absenteeism, along with an improvement in worker productivity and morale.

These examples highlight the potential of exoskeletons to transform the construction industry by improving worker safety, reducing fatigue, and enhancing productivity.

6. THE FUTURE OF EXOSKELETONS IN CONSTRUCTION

5.1 Advances in Exoskeleton Technology

As research and development in the field of exoskeletons continue, new advancements are being made that will further enhance the capabilities of these devices. Innovations in materials science, robotics, and artificial intelligence (AI) are expected to result in lighter, more intuitive exoskeletons that are easier to use and more affordable.

One exciting area of development is the integration of AI into exoskeletons, allowing the devices to learn from the wearer's movements and adapt to their specific needs. For example, an AI-powered exoskeleton could adjust the level of support it provides based on the worker's posture, fatigue level, or the task at hand.

5.2 Increased Adoption of Exoskeletons

As the technology becomes more refined and accessible, the use of exoskeletons in construction is likely to increase. In addition to improving worker safety and productivity, exoskeletons may become a standard part of construction site protocols, similar to hard hats and safety harnesses.

Moreover, with growing awareness of the importance of worker health and safety, along with increasing regulatory pressures, construction companies may be incentivized to adopt exoskeletons as part of their overall safety strategies.

7. CONCLUSION

Exoskeletons represent a groundbreaking innovation in the construction industry, offering the potential to revolutionize the way construction tasks are performed. By enhancing worker safety, reducing fatigue, and increasing productivity, exoskeletons can help address some of the most pressing challenges in the construction sector.

While challenges such as cost and ergonomics remain, the future of exoskeleton technology looks promising. As advancements continue and the benefits become more widely recognized, exoskeletons are likely to become an integral part of construction projects, ensuring safer, more efficient, and more sustainable worksites.

REFERENCES

1. OSHA. "Ergonomics: The Study of Work." Occupational Safety and Health Administration, www.osha.gov/ergonomics.
2. National Institute for Occupational Safety and Health (NIOSH). "Exoskeletons and Ergonomics." www.cdc.gov/niosh/topics/ergonomics.
3. Ford Motor Company. "Exoskeleton Technology at Ford." www.ford.com/innovation.

CARBON CAPTURE UTILIZATION AND STORAGE IN CONSTRUCTION

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ABSTRACT

Civil engineering, traditionally regarded as a technical field, has long dealt with the design, construction, and maintenance of infrastructure. However, in recent years, the importance of human psychology in shaping civil engineering outcomes has gained recognition. This article explores how psychological principles influence civil engineering projects, addressing the needs and behavior of the people who interact with these structures. Through understanding human behavior, perception, and decision-making, engineers can create spaces that foster well-being, safety, and productivity. This paper also examines case studies and examples that showcase the impact of psychological considerations in civil engineering projects and discusses future prospects for incorporating psychology into engineering design and practices.

1. INTRODUCTION

According to the Global Status Report for Buildings and Construction published by GlobalABC in 2020, global building energy consumption was stable year over year, but energy-related CO2 emissions rose to 9.95 Gt CO2 in 2019 due to a change from direct use of coal, oil, and traditional biomass toward electricity, which had a greater carbon content because of the high percentage of fossil fuels used in generation. Meeting this challenge will require a fully diversified portfolio of approaches, including much more energy-efficient end-use electrification of energy services coupled with reduced greenhouse gas (GHG) emissions from electric power generation, fuel switching in transportation and electric power generation, deployment of additional renewable power generation, land use changes toward lower-emission agriculture; emission reductions of short-term forcers such as black carbon, CH4, and hydrofluorocarbons (HFCs); and capture and use or storage of CO2(CCUS), among many others. The integrated assessment suggests that portfolios that contain substantial levels of deployment of CCUS exhibit a lower estimated cost than portfolios that do not contain any level of CCUS.

Carbon capture, utilization, and storage, or CCUS, is a family of technologies that capture carbon dioxide emissions, which can be used or stored to prevent them from entering the atmosphere. Any CCUS projects have to capture the CO2 from some emission stream, transport it to a storage site or a utilization site, and then store it underground or use directly as feedstock. This is broken into carbon capture and utilization (CCU) and carbon capture and storage(CCS).

Carbon capture and utilization (CCU) can recover CO2 from large point sources, including power plants and industrial facilities. The captured CO2 can be used either directly or indirectly in a variety of products, or stored underground in geologic formations. Carbon Capture and Storage (CCS) is a technology that captures carbon dioxide (CO2) from industrial sources as well as the atmosphere to eventually store it underground. In the following pages, the core aspects of carbon capture utilization and storage (CCUS) in construction are dealt with in order to emphasize just how such technologies may change the environmental influence of this sector. The potential for CCUS to take carbon emissions down and spur more sustainable practices is enormous in the construction sector.

2. CARBON CAPTURE

Carbon capture involves capturing CO2 emissions right at their source such as power plants or industrial facilities before they can enter the atmosphere. In the construction sector, this process is particularly relevant in cement production, which is a major contributor to CO2 emissions. Several methods are used to capture carbon:

Post-Combustion Capture: This technique removes CO2 from the flue gases (a mixture of gases and other substances that are released from combustion plants) produced after fossil fuels are burned. It typically utilizes solvents like amines to absorb the CO2.

Pre-Combustion Capture: In pre-combustion capture, the fossil fuel is partially oxidized and reacted with steam to produce syngas (CO and H2O), which will be further converted to CO2 and H2 enabling the separation of CO2 before combustion takes place. H2 can be used as fuel, and CO2 is captured by techniques before combustion taking place. The operating pressure is 20–30 bar, and the temperature is high.

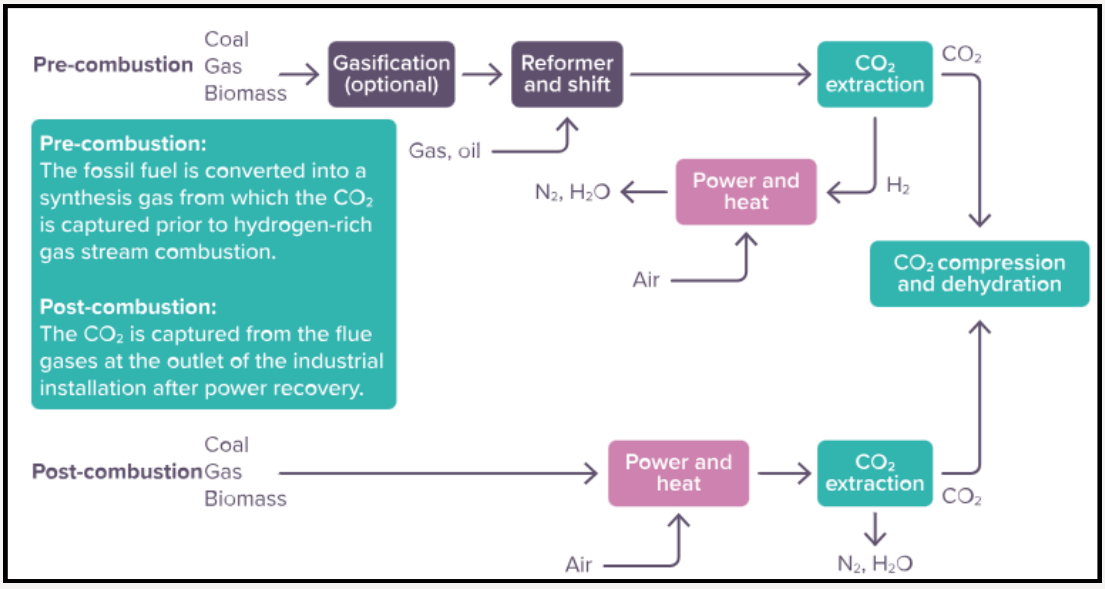

Figure 1: Pre-combustion and Post-combustion carbon capture

3. CARBON STORAGE

Once CO_2 is captured, it needs to be safely stored to prevent it from re-entering the atmosphere. There are two primary storage methods:

Geological Storage: This method involves injecting CO_2 deep into underground rock formations, where it can be securely contained for long periods. The CO_2 capture and storage process consists of four components; capturing, compressing, transporting, and injecting CO_2. Initially, CO_2 is captured from stationary CO_2 sources (e.g., power generation plants, chemical processing plants, coal-fired based plants, and several other non-stationary carbon emitters, such as automobiles). These sources are responsible for emitting billions of tons of CO_2 into the environment, half of which is used in natural carbon cycles and other mechanisms. Then, CO_2 (captured) is compressed using high-pressure compressors (with an operational capacity of more than 10 MPa). They are transported to storage locations via pipelines and cargo ships. The transportation of CO_2 is considered safe due to its non-flammable nature compared to natural gas. Finally, compressed CO_2 is injected into underground formations at adequate injection parameters (e.g., rate of injection and injection pressure) for permanent immobilization.

Mineralization: Carbon mineralization is a trapping technique that can permanently store CO_2 in reactive rocks such as basalt. This process transforms CO_2 into stable minerals, effectively locking the carbon away in solid form. By doing this, the CO_2 is permanently stored, minimizing the risk of leakage.

4. CARBON UTILIZATION

Utilizing captured CO_2 in construction materials is a promising avenue for reducing emissions. Here are some notable applications:

Carbonated Concrete: CO_2 in the atmosphere reacts with the calcium oxide in concrete to form calcium carbonate; a process called carbonation. Over the lifecycle of concrete, carbonation will result in the reabsorption of around a third of the CO_2 emitted when making cement, significantly reducing the whole-life CO_2 footprint of both the cement and the concrete for which it is used.

Carbon dioxide (CO_2) curing: It utilises CO_2 to improve the performance of concrete and reduce the carbon footprint of concrete operations. During mixing, CO_2 is injected into concrete, where it reacts with calcium oxide ions in the cement to form calcium carbonate. This process is called mineralization.

Synthetic Fuels and Chemicals: CO_2 can be converted into synthetic fuels or chemical feedstocks, providing valuable resources for construction processes.

Carbon nanofiber Production: Scientists at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory and Columbia University have developed a way to convert carbon dioxide (CO_2), a potent greenhouse gas, into carbon nanofibers, materials with a wide range of unique properties and many potential long-term uses. Their strategy uses tandem electrochemical and thermochemical reactions run at relatively low temperatures and ambient pressure. This approach could successfully lock carbon away in a useful solid form to offset or even achieve negative carbon emissions. We can put the carbon nanofibers into cement to strengthen the cement. This would lock the carbon away in concrete for at least 50 years, potentially longer. By then, the world should be shifted to primarily renewable energy sources that don't emit carbon. This process also produces hydrogen gas (H_2), a promising alternative fuel that, when used, creates zero emissions.

Nesquehonite ($Mg(HCO_3)OH{\cdot}2H_2O$): It is a solid product of CO_2 mineralization with cementitious properties. It constitutes an "MHCH" (magnesium hydroxy-carbonate hydrate) phase and, along with dypingite and hydromagnesite, is considered to be a promising permanent and safe solution for CO_2 storage with potential utilization as a supplementary material in "green" building materials.

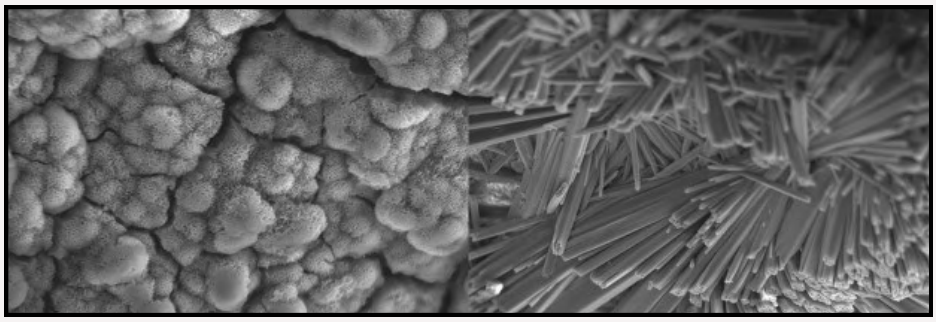

Figure 2: Nesquehonite

5. CONCLUSION

Carbon capture utilization and storage (CCUS) offers the construction industry a promising way to reduce its environmental impact. By implementing various carbon capture techniques and using the captured CO_2 in building materials, the sector can make significant progress toward sustainability. Although there are challenges to consider, like economic costs and energy demands, the advantages are compelling. CCUS can lower carbon footprints, improve the performance of materials, and support a circular economy. As the world intensifies its fight against climate change, integrating CCUS into construction practices will be essential for creating a more sustainable and resilient future. Investing in these technologies not only benefits the environment but also positions the industry as a leader in innovation and responsibility.

REFERENCES

1. Franklin M. Orr Jr. (2018): 'Carbon capture, utilization, and storage: An update' Stanford University, SPE Journal, December 2018
2. Mohd Hanifa , R. Agarwal , U. Sharma, P.C. Thapliyal , L.P. Singh (2023): 'A review on CO2 capture and sequestration in the construction industry: Emerging approaches and commercialised technologies', Journal of CO2 Utilization 67 2023
3. Edward S. Rubin,Hari Mantripragada,Aron Marks,Peter Versteeg, John Kitchin (2012): 'The outlook for improved carbon capture technology' ,2012
4. Muhammad Ali,Nilesh Kumar Jha,Nilanjan Pal,Alireza Keshavarz,Hussein Hoteit,Mohammad Sarmadivaleh (2022): 'Recent advances in carbon dioxide geological storage, experimental procedures, influencing parameters, and future outlook', Earth science reviews 225 2022

LIDAR IN CIVIL ENGINEERING

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ABSTRACT

LiDAR (Light Detection and Ranging) technology has transformed the civil engineering industry by providing highly accurate and detailed 3D models of the Earth's surface. Its applications encompass digital elevation models, progress updates, geospatial mapping, and more. LiDAR enables efficient planning, design, and construction processes, while significantly improving accuracy and safety. By reducing errors and surveying time, LiDAR technology has become an indispensable tool for civil engineers, enhancing project outcomes and decision-making capabilities. Its benefits are numerous, and its potential is vast.

1. INTRODUCTION

LiDAR stands for Light Detection and Ranging. It's a remote sensing method that uses light in the form of a pulsed laser to measure variable distances to the Earth. These light pulses generate precise, three-dimensional information about the shape of the Earth and its surface characteristics. A LiDAR system emits laser pulses that bounce off surfaces and return to the sensor. By measuring the time it takes for the pulses to return, LiDAR calculates distances with incredible accuracy.

Civil engineering relies on accurate data for planning, design, and construction. Traditional surveying methods can be time-consuming and less accurate. LiDAR, however, provides precise and detailed data quickly, revolutionizing the way civil engineers work. Here's a closer look at how LiDAR benefits civil engineering.

2. THE BENEFITS OF LIDAR IN CIVIL ENGINEERING

1. Digital Elevation Model (DEM)

A DEM is used as a digital depiction of the topography of surveyed terrains. Scanning an area with a LiDAR sensor quickly yields results, showing terrain variation such as slopes, which can then be considered in the planning process by civil engineers. This is ideal for detecting potential issues when building infrastructure like roads or railways.

2. Progress Updates

A large project has many stakeholders that need regular progress updates. Scans using LiDAR technology show change over time and create clear reports on the progress of a project. Additionally, 3D point clouds can be compared with planned CAD drawings to show live progress of the real-world structure and the plans.

3. Record Keeping
Keeping accurate records of a project throughout its lifecycle is important. Access to plans may be needed in the future to settle disputes, for extension work, or for reference if the structure suffers damage. Conducting regular scans using LiDAR technology provides 3D models of a project before, during and after completion.
4. Ecological and Land Classification (ELC)
ELC surveys provide the biological and physical information of a landscape. LiDAR gives civil engineers a thorough map of the land, which can be combined with an ELC survey for the sustainable management of the area being surveyed.

5. Tunnel Surveying
LiDAR is an ideal solution for capturing data from tunnels. Accurate and detailed 3D point clouds can be used to analyse, assess, or model a tunnel ahead of construction of railway tracks or roads. Additionally, 3D LiDAR data can depict imperfections in a tunnel, highlighting potential structural issues.

3. APPLICATIONS

3.1 Geospatial Mapping and Surveying
Lidar has revolutionized geospatial mapping and surveying, providing highly accurate and detailed topographic information. It enables rapid and cost-effective acquisition of terrain data, building footprints, and infrastructure features. Lidar-based digital elevation models (DEMs) and digital surface models (DSMs) are utilized for land surveying, urban planning, and infrastructure design.

3.2 Flood risk mapping
LiDAR is one of the fastest and most accurate methods of producing a Digital Elevation Model (DEM). Using the LiDAR-derived DEM, hydrologists can predict the extent of floods and work out mitigation and remediation strategies.

3.3 Landslide analysis
In geology, a combination of airborne LIDAR and GPS is evolving into a vital tool for fault analysis and measurement. Using cloud-based registration software, Airborne LIDAR can be combined with more detailed terrestrial LiDAR to monitor massive areas such as natural glaciers or man-made quarries.

4. CONCLUSION

LiDAR technology has revolutionized civil engineering, offering unprecedented accuracy and efficiency. Whether you're planning a new road, constructing a bridge, or monitoring infrastructure, LiDAR provides invaluable data to ensure success. Embrace LiDAR to elevate your projects to new heights.

REFERENCE

[1] Q & A The Question & Answer Engine. How is LiDAR used in Civil Engineering? (Ultimate Guide), July 19 2024.

[2] Faro. Faro sphere XG, Your Digital Reality Platform. What are the benefits of LiDAR in Civil Engineering.

[3] Vercator. 4 LiDAR Applications in Civil Engineering By Charlie Cropps MRICS. May 6 2021.

EARTHQUAKE ENGINEERING

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ABSTRACT

This chapter summarizes the fundamental concepts of earthquake engineering. Causes of earthquakes, earthquake measuring scales, seismicity and characteristics of strong ground motion are discussed. The intensity and magnitude of the earthquake are differentiated. An introduction to response of structures to earthquake ground motion is represented .Techniques used in building earthquake resistant buildings are also discussed here. To acquire the knowledge of seismic sensors and warning system are important. It also included in this article.

1. INTRODUCTION

Earthquake engineering involves designing structures to withstand hazardous earthquake exposures. Earthquake engineering is a sub-discipline of structural engineering. The main objectives of earthquake engineering are to understand interaction of structures on the shaky ground; foresee the consequences of possible earthquakes; and design, construct and maintain structures to perform at earthquake in compliance with building codes. Vibrations of the earth surface caused by waves originating from a source of disturbance in the earth mass is known as Earth quake.

2. EARTHQUAKE ENGINEERING PRACTICE

Earthquake engineering practice in general is strongly influenced by seismic codes that are currently in force. Therefore, as codes become more theoretically sound, as evidenced for example by the performance-based approach adopted in FEMA 273/302, practitioners in earthquake engineering will need to become more familiar with the theoretical background of related seismic disciplines. In addition to some aspects of engineering seismology and seismic geology, earthquake engineers need to become more familiar with the principles of geotechnical earthquake engineering, structural dynamics, or other related fields, depending on their specialty.

This trend toward performance-based seismic evaluations has already been manifested in engineering practice, and it is expected to continue for the foreseeable future. Balancing and complementing this increasingly theoretically sound practice will be the continuing lessons learned from actual earthquake experience. The healthy growth of earthquake engineering practice depends on the tempering of sound theory by actual experience in earthquakes. Consistent with this general trend, we expect an increasing trend in earthquake engineering practice toward the use of probabilistically estimated response spectral values in seismic design and retrofit.

3. INTRODUCTION TO EARTHQUAKE HAZARD, RISK, AND DISASTERS

Earthquake engineering is most useful in reducing the risk the population is exposed to by designing new structures so they will resist strong ground shaking(Tolis).However, special techniques have to be developed and taught in regions where the construction materials and skills are limited (Dixit et al). Unfortunately, the best efforts of earthquake engineers are nixed, if greedy developers and companies find ways of ignoring building codes (Bilham). A related problem influencing damage patterns is that of often unknown soil conditions beneath the built environment(Parvez& Rosset).

4. TECHNOLOGY-BASED TECHNIQUES TO BUILD EARTHQUAKE-RESISTANT STRUCTURES

New technology plays an important role in expanding our understanding of earthquakes and developing creative solutions to build earthquake-resistant structures. Seismic retrofitting, seismic analysis, and seismic sensors are aspects of this process. The best earthquake-resistant construction materials have an important quality in common: high ductility. Ductility refers to the material's ability to move and change shape without breaking or losing strength. Traditionally, steel and wood are the best and most common earthquake-resistant materials.

Shape-memory alloys (SMAs) are fabricated metals that only change shape when cold and then return to their original shape when heated. "Cold" in this case could be as low as -100 degrees Celsius (-148 Fahrenheit). SMAs are highly ductile and create a damping effect due to their ability to dissipate heat.

Seismic invisibility cloaks are concentric rings of material surrounding a building's foundation. These rings divert seismic waves around buildings. Scientists are still experimenting to find ideal materials (plastic, metal, trees, etc.) and configurations to create these rings. The drawback to this method is that it simply displaces vibrations instead of dissipating them.

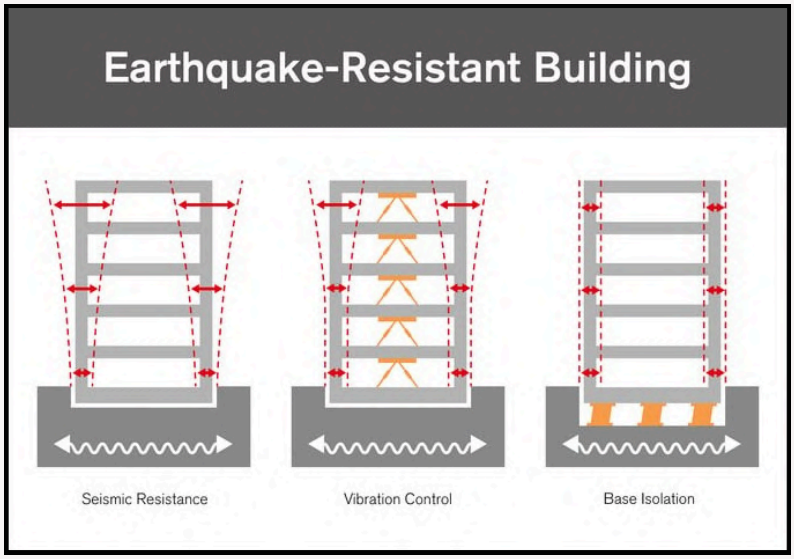

Figure 1: Earthquake-Resistant Design

5. SEISMIC SENSORS AND WARNING SYSTEMS

Monitoring seismic activity is important both to give structural engineers data about a site's geological features and to improve early-warning systems. As mentioned previously, predicting earthquakes isn't an exact science, but sending out alerts when an earthquake is happening is more feasible. Seconds make a difference in getting people to safety, particularly for those farther from the epicenter.

Ocean-based sensors can also detect underwater earthquakes to predict tsunamis and send alerts that include wave height and arrival time. When Tonga erupted in January 2022, sending a tsunami across the globe, the US National Oceanic Atmospheric Administration issued a tsunami advisory. Coastal areas received the information and were prepared well in advance of the wave's arrival.

6. CONCLUSION

Solutions to earthquake engineering problems, either design of structures, or simulation of accelerograms, or estimation of seismic hazard, are today very different than they were before a strong interaction between engineers and seismologists started in the 1970s. This interaction, which gave birth to the new discipline of engineering seismology, gathered force due to the strict design requirements in building nuclear power plants, and is flourishing at present. Today, the difference between strong motion—previously a domain of engineers—and weak motion—seismologists' realm—has disappeared, due to progress in instrumentation and to the awareness that both weak- and strong-motion data are useful to understand the nature of earthquakes. Indeed, today it is inconceivable to study detailed rupture processes of large earthquakes without near-source strong-motion data. Similarly, it is unimaginable to synthesize an accelerogram without imposing restrictions obtained from seismological theory.

REFERENCE

[1] Science Direct. Earthquake Engineering. AI generated definition based on: Earthquake Hazard, Risk and Disasters, 2014

[2] C.E.J, Civil Engineering Journal. Structural and Earthquake EngineeringVol 10, No 7 (2024).

[3] IEEE Public Safety Technology. Earthquake-Resistant Building Technology.27 July 2022

GIS SOLUTIONS FOR CIVIL ENGINEERING

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ABSTRACT

Civil engineering is about developing and sustaining infrastructure. The profession covers many areas of interest and a broad range of expertise. As a result, civil engineers work with a voluminous amount of data from a variety of sources. Geographic information system (GIS) technology provides the tools for creating, managing, analysing, and visualizing the data associated with developing and managing infrastructure. GIS allows civil engineers to manage and share data and turn it into easily understood reports and visualizations that can be analyzed and communicated to others. This data can be related to both a project and its broader geographic context. It also helps organizations and governments work together to develop strategies for sustainable development. Thus, GIS is playing an increasingly important role in civil engineering companies, supporting all phases of the infrastructure life cycle.

1. INTRODUCTION :WHY GIS?

GIS software is interoperable, supporting the many data formats used in the infrastructure life cycle and allowing civil engineers to provide data to various agencies in the required format while maintaining the data's core integrity. GIS technology provides a central location to conduct spatial analysis, overlay data, and integrate other solutions and systems. Built on a database rather than individual project files, GIS enables civil engineers to easily manage, reuse, share, and analyse data, saving time and resources.

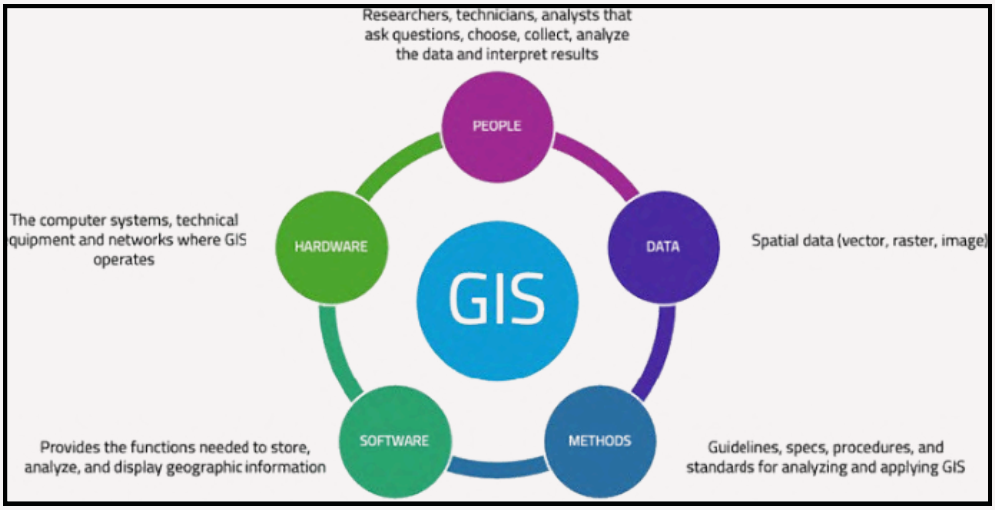

Figure 1: Components of GIS

2. KEY FEATURES

2.1 Infrastructure Life Cycle

This architecture provides the tools to assemble intelligent GIS applications and improve a project process by giving engineers, construction contractors, surveyors, and analysts a single data source from which to work. Centrally hosting applications and data makes it easy to manage, organize, and integrate geographic data, including CAD data, from existing databases to visualize, analyse, and make decisions

2.2 Data Collection

It has specific functions to collect precise site data used for predesign analysis; design; and calculations including field survey, topography, soils, subsurface geology, traffic, lidar, photogrammetry, imaging ,sensitive environmental areas, wetlands, hydrology, and other site-specific design-grade data.

2.3 Environmental Analysis

It provides analysis to support design including hydrology analysis,volume calculations, soil load analysis, traffic capacity, enivironmental impact, slope stability, material consumption, runoff, erosion control, and air emissions.

2.4 Design

It allows creation of new infrastructure data for new civil work works including grading, contouring, specifications, cross sections, design calculations, mass haul plans, environmental mitigation plans, and equipment staging.

2.5 Construction

It provides the mechanics and management for building new infrastructure including take-off, machine control, earth movement, intermediate construction, volume and material, and payment calculations; materials tracking; logistics; schedules; and traffic management.

2.6 Data Collection As-Built Surveying

GIS provides the tools to collect precise site data and document existing conditions. With as-built surveying infrastructure data, operators use defined, operational, industry-standard data models. As-built surveying with GIS technology permits the surveyor to deliver data into operational GIS, eliminating costly data conversion and reducing errors.

2.7 Operations/Maintenance

Spatial selection and display tools allow you to visualize scheduled work, ongoing activities, recurring maintenance problems.

2.8 Site Analysis

Civil engineers use GIS to keep track of multiple urban and regional indicators, forecast future community needs, and plan accordingly to guarantee quality of life in liveable communities for everyone. A GIS solution provides tools to help them reach their agency missions while doing more and spending less.

2.9 Critical Infrastructure Protection

GIS technology provides a situational awareness tool for fusing information, from flood elevation and evacuation routes to a bridge's structural specifications and inspection results. Add current traffic and weather data, draw buffer protection zones Emergency managers use the enterprise GIS database to

- Identify critical infrastructure and hazards within affected areas.
- Prepare evacuation routes for at-risk populations.
- Provide accurate damage estimates.

3. CONCLUSION

There are ample evidences of applying the recent advances in satellite based remote sensing and GIS technology in various fields of civil engineering. India's space programme ensuring continuous availability of RS data and launching of future satellites carrying high spatial and spectral resolution sensors can go a long way in providing useful information required for civil engineering application.

REFERENCES

- WWW.WIKIPEDIA.COM
- WWW.ESRI.COM
- (PHD paper reference) https://www.slideshare.net/amalcvarghese

SOIL PIPING

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1. INTRODUCTION

We all remember with heavy hearts how massive landslides transformed Wayanad's Mundakkai Junction and Chooralmala into ghost towns. The once-bustling areas were buried under mounds of mud, debris, and massive boulders carried down by floodwaters from the hilltops, making it difficult to believe they were once thriving communities.

Landslides happen when sections of a hillside slide downward. In Wayanad's Chooralmala and Mundakkai areas, experts have identified soil piping as a key factor contributing to these landslides. They explain that the surface soil in these regions is unconsolidated and poorly sorted. Rainwater infiltrates the ground, dissolving the clay content and forming interconnected underground tunnels. These tunnels facilitate significant water discharge and soil erosion, a process referred to as piping. This subsurface erosion weakens the soil structure, making the slopes more susceptible to landslides.

2. SOIL PIPING

Soil piping, also known as tunnel erosion, is a process of subsurface soil erosion caused by water percolation that creates pipe-like tunnels below the ground, particularly in loose or non-lithified materials. This phenomenon is widespread in many districts of Kerala, with the exception of Thiruvananthapuram, Kollam, and Alappuzha, where soils affected by soil piping have not been reported. The size of these subsurface tunnels can range from just a few centimetres to several meters.

Soil piping is a naturally occurring, hydraulic process that leads to the development of macropores (large, air-filled voids) in the subsurface that are associated with landslides and collapse subsidence

Figure 1: Soil piping

3. SIGNIFICANCE OF SOIL PIPING

Soil piping is significant in both hydrogeology and shallow geohazards research due to its influence on water flow and surface stability. During storms, soil pipes can contribute significantly to streamflow, particularly in the form of quick-flow or base-flow, which is often underestimated. These underground networks are recharged by vertical infiltration and rising groundwater (Jones, 2010).

Soil piping also plays a role in subsidence, as erosion or ground vibrations can cause portions of the pipe network to collapse, leading to surface depressions or craters, commonly referred to as sinkholes. Such collapses often occur after periods of prolonged or intense rainfall, as seen during the widespread sinkhole events reported in the UK in 2014.

Figure 2: Soil Piping
Black Mountains

In certain conditions, rapid pore-water pressure buildup can trigger soil instability and landslides, and desiccation cracks, recharging soil pipe networks and highlight how prolonged droughts can increase the risk of sinkholes or landslides during subsequent wet periods.

In short implication of soil piping can be listed as follows:

- Soil Erosion and Land Degradation: Soil piping accelerates subsurface erosion, contributing to land degradation and loss of fertile soil, especially in agricultural areas.
- Landslides and Slope Instability: By weakening the structural integrity of slopes, soil piping increases the likelihood of landslides, particularly in hilly or mountainous regions.
- Hydrology and Water Flow: Soil pipes can significantly contribute to base-flow and quick-flow in rivers and streams during storms, affecting stream hydrographs and flood patterns.
- Sinkhole Formation: As underground tunnels collapse, sinkholes may form on the surface, posing risks to buildings, roads, and other infrastructure.
- Impacts on Infrastructure: The formation of underground voids can lead to ground subsidence, damaging roads, bridges, and buildings.
- Environmental Hazards: In addition to causing immediate geohazards like landslides and sinkholes, soil piping can alter local hydrology and ecosystems by changing water flow patterns and soil structure.

4. FACTORS INFLUENCE THE DEVELOPMENT OF SOIL PIPING

- Soil Composition: Loose, unconsolidated, or poorly sorted soils, especially those rich in silt and clay, are more prone to erosion and piping.
- Water Infiltration: High rainfall, poor drainage, and rapid infiltration increase subsurface water flow, promoting tunnel formation.
- Topography: Steeper slopes accelerate water movement, enhancing erosion and piping formation in hilly or sloped terrains.
- Land Use and Vegetation: Deforestation, agricultural practices, and improper land use reduce soil stability, making it more susceptible to piping.
- Climate: Prolonged droughts can create desiccation cracks that recharge soil pipes during wet periods, while intense rainfall can accelerate piping.
- Ground Vibrations: Activities like construction or seismic events can destabilize subsurface tunnels, leading to collapses.
- Soil Chemistry: The presence of soluble materials and low soil cohesion facilitates the leaching and removal of fine particles, aiding tunnel development.

5. PREVENTIVE MEASURES

1.Proper Drainage Systems

- Installation of drain tiles or perforated pipes: Helps reduce water pressure and prevents water from accumulating in one spot.
- Graded slopes: Ensure that surface water flows away from structures like buildings or roads to reduce the chance of water infiltrating the soil.
- Check dams or silt fences: These can slow down water movement and reduce erosion.

2. Soil Compaction

- Proper soil compaction during construction can help reduce voids within the soil where water might accumulate and flow, thus minimizing the risk of piping.

3. Vegetation Cover

- Planting grass, shrubs, or trees: Vegetation stabilizes soil by creating root networks that hold the soil in place and prevent water from eroding the surface.
- Using mulch or ground cover: Can reduce surface erosion and promote water infiltration at a slower rate, reducing the likelihood of piping.

4. Geotextiles and Erosion Control Materials

- Geotextile fabrics: Placed within soil layers, these fabrics help control erosion by allowing water to flow through while retaining soil particles.
- Riprap or gravel layers: These materials can prevent high water flows from causing erosion at the surface, which can contribute to piping.

5. Grout Injection or Soil Stabilization

- Chemical grouting or slurry injection: Can be used to fill voids or stabilize soil that might be prone to erosion.
- Lime or cement treatment: Adding lime or cement to weak soils can increase their cohesion and reduce the risk of internal erosion.

6. Monitoring and Inspection

- Regular inspections: Especially around critical infrastructure such as dams, levees, or retaining walls, can identify early signs of soil piping.
- Use of sensors or geophysical tools: Advanced techniques such as ground-penetrating radar can be used to detect early signs of subsurface erosion.

7. Proper Water Management

- Controlled irrigation and drainage systems: In agricultural or landscaped areas, controlling the amount of water delivered to the soil can prevent saturation and reduce piping risks.
- Diversion ditches or canals: Can be used to divert excess water away from sensitive areas prone to piping.

6. CONCLUSION

The growing impact of human interference on the environment has become a dominant factor in the rising frequency and intensity of natural disasters, such as floods and hurricanes. As human activities expand, they alter natural systems in ways that disrupt ecological balance, leaving the planet more vulnerable to catastrophic events. This have to be viewed seriously.

REFERENCES:

1. Anita Bernatek-Jakiel a, Jean Poesen: Subsurface erosion by soil piping: significance and research needs “Elsavier -Earth-Science Reviews Volume 185, October 2018, Pages 1107-1128
2. Jones, J. A. A. (2004). Implications of natural soil piping for basin management in upland Britain. Land Degrad. Dev., 15: 325-349.
3. Sujaina M. Soniya V. P Gowthamchand N. J. “Soil Piping: Causes and ManagementV”olume-2, Issue-9, July, 2023 E-ISSN: 2583-1755
4. K V SarathK V SarathShaji E.Shaji E.V. DeepchandV. DeepchandShow all 5 authorsC.S. SubeeshChandran Subsurface erosion by soil piping: A case study from Adoor-Pandi Area, Kasaragod, Kerala, India Conference: 4th Disaster Risk and Vulnerability Conference, October, 2020At: School of Environmental Sciences Mahatma Gandhi UniversityVolume: 4

CONSULTANCY WORKS FROM GOVERNMENT DEPARTMENTS AND PRIVATE FIRMS

The faculty members in the department are actively involved in the consultancy works from both government departments and private firms. Important Civil engineering fields in which consultancy works are being done include:

Nature of consultancy work	**Associated Government department/Private firm**
Total station Surveying	Local self Government department (Rebuild Kerala Initiative), Kerala
Geotechnical investigations	Local self Government department, Kerala
Material testing (Concrete)	Private firms and government departments
Water qualitymonitoring	Water resources department, Kerala
Structural design	Private firms and government departments

Students are also given opportunity to participate in the consultancy works, so that, they can associate with real time projects. Some additional facilities/equipments were added to the laboratories to carry out consultancy works and funded projects.

RESEARCH CONTRIBUTIONS 2023-2024

PAPER PUBLICATIONS

SL. NO.	Authors	Title of the paper	Publication Details
1.	Akshaya M. A., Fathima Kulzum N. A., Athul V. M., Beslin Biju, Kiran Babu A. R.	Study on shear strengthening of beams aided by geopolymers	International Journal of Creative Research Thoughts, Volume 12, Issue 1, January 2024, ISSN: 2320- 2882
2.	John Jose Emmatty, Rahna K. Rajeev, Helma Mariya Davis, Dr Anjali P. Sasidharan	Microbe-Induced Calcium Carbonate Precipitation Mediated Brick Manufacturing	International Journal of Creative Research Thoughts, Volume 11, Issue 11, November 2023, ISSN: 2320- 2882
3.	Alphy Anto, Dr Abhilasha P. S.	Bamboo as a sustainable building Material	International Journal of Creative Research Thoughts, 2023, ISSN: 2320-2882
4.	Krishna Bhadran P. S., Nandan K. V., Sreeranjini Sreekumar, Ms. Seetha Pisharikkel	Study on effect of graphene oxide on the mechanical performance of Graphene Oxide blended cement concrete	International Research Journal of Engineering and Technology, 2023, ISSN: 2395-0072
5.	Prince Kesav, Dr Abhilasha P. S.	Experimental and Analytical Investigation on Strengthening of Cutout in a Composite Slab	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072

PAPER PUBLICATIONS

SL. NO.	Authors	Title of the paper	Publication Details
6.	Sijin Varghese, Dr Abhilasha P. S.	Axial Performance of GFRP Wrapped Partially Encased Composite Column with Corrugated Web	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072
7.	Fathima R. M., Nisha Varghese	Development of Optimum Lightweight Cold-Formed Steel Composite Built-Up Beams	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072
8	Sreelakshmi Saji, Nisha Varghese	Strengthening of fibre reinforced concrete columns using high strength concrete filled steel tubes	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072
9.	Arya C., Gopu Surjith, Hana P. Basheer, Indrajith J. S., Dr Anjali P. Sasidharan	Greywater Treatment Technique Using Fruit Peels	International Journal of Scientific Research in Engineering & Technology, 2024, ISSN: 2395-0072
10.	Navaz K. A., Rudhira M. R., Saranya V. M., Sneha M. S., Dr Anjali P. Sasidharan	Efficacy of Activated Carbon in Removing Sulphate and Chloride from Sea Water	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072

RESEARCH CONTRIBUTIONS 2023-2024

PAPER PUBLICATIONS

SL. NO.	Authors	Title of the paper	Publication Details
11.	Jenitta C. S., Ardra P. Nair	Flexural Behaviour of Hybrid Double-Skin Tubular Beams Having Perfobond Hoop Shear Connectors	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072
12.	Muhammed Suhail A. S., Kiran Babu A. R.	Study on Concrete Filled Steel Tube Columns Reinforced with Diagonal Stiffener	International Research Journal of Engineering and Technology, 2024, ISSN: 2395-0072

PAPER PRESENTATIONS

SL. NO.	Authors	Title of the paper	Journal/Conference
1.	Hridya K. Sekharan, Muhammed Adil, K. M. Musammil, Kalyani Vijayakumar	Effect of Microbial Stabilization on High, Intermediate and Low Compressible Clay	8th International Technical Conference on Frontiers of Hydraulic and Civil Engineering Technology,2023, ISBN: 978- 1-64368- 464-2

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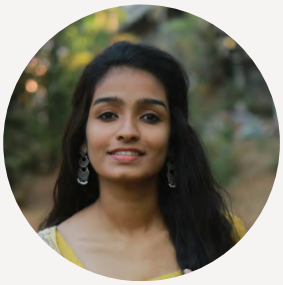

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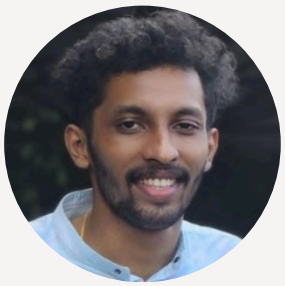

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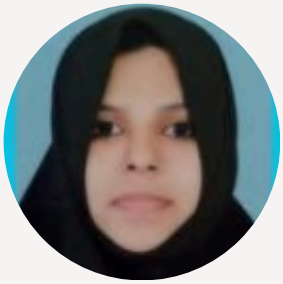

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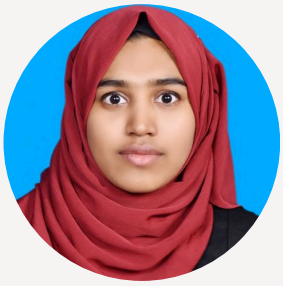

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"The best way to predict the future is to create it"

-ABRAHAM LINCOLN

VIDYA ACADEMY OF SCIENCE AND TECHNOLOGY
THALAKKOTTUKARA

DEPARTMENT OF CIVIL ENGINEERING
IN ASSOCIATION WITH VYVIDH '24 PRESENTS

VASTATVA 2024

VASTATVA ‘24

INTRODUCTION

The Civil Engineering Department of Vidya Academy of Science and Technology conducted a two-day tech fest named "Vastatva" on February 29th and March 1st, 2024. The event aimed to provide a platform for engineering students from various institutions to showcase their technical skills and knowledge.

EVENTS AND PAVILIONS

The Department of Civil Engineering hosted techfest Vastatva ‘24 on February 29th and March 1st. The main expo, Agira, was centered on sustainable, disaster-resilient infrastructure, and innovative technologies. Focus areas included eco-friendly materials, resilient urban planning, and advanced disaster response mechanisms. This event showcased cutting-edge initiatives in civil engineering, emphasizing sustainability and the interconnectedness of elemental forces (earth, water, fire, wind, and space) for a harmonious habitat.

Agira at Vastatva ‘24 was a significant platform promoting sustainable and resilient civil engineering solutions. The highlight of Agira was a suspension bridge featuring a design utilizing sustainable materials for enhanced durability. The bridge was engineered to safely support a capacity of 5 to 6 persons, made up of using 5 feet steel pipes and 20 feet pipes. The construction prioritized cost-effectiveness without compromising structural integrity. The exhibition showcased diverse architecture models, providing a comprehensive display of various design approaches within the field.

SAHA Junior Expo served as a comprehensive platform for aspiring civil engineers, offering exposure to diverse disciplines, including surveying, transportation, structural engineering, geotechnical engineering, water resources, and professional ethics of engineers. Attendees benefited from insights into cutting-edge advancements, enhancing their practical understanding of the field. The event also facilitated networking opportunities with professionals and peers, acting as a catalyst for knowledge exchange and career development in civil engineering. In today's era of environmental challenges and increased disasters, civil engineering is crucial for mitigating risks and promoting sustainable living. The Expo facilitates knowledge exchange, fostering collaboration among professionals
and academia

This contributes to the evolution of civil engineering practices, prioritizing sustainability, resilience, and community well-being for a harmonious and secure future.

Apart from the expo, the tech fest featured several technical games, such as Design wizard, Girder King, Workshop on Tekla structure detailing, Seminar, and Concrete crush. These games provided a platform for students to showcase their technical skills and knowledge. The

games were challenging and allowed students to demonstrate their creativity and problem-solving abilities.

Design wizard

A CAD drawing is provided for the participants and the one who completed the replica of the given drawing first, meeting all the provided conditions, won the game.

Girder King

Girder models are made with given ice-cream sticks and glue. The maximum load bearing girder wins the game.

Concrete Crush

The participant casted concrete cube with given materials and after 7 days, the cube with the most strength wins the game.

Workshop on Tekla structure detailing

A free workshop on Tekla structure detailing by Mr. Mohammed Haris in association with keywor technologies was conducted with full attendance.

Seminar on Perception of sustainability and its dialectics

The session was handled by Mr. Neerad Mohan. He is an entrepreneur and founder of the firm "Studio Plantale". He discussed the topic 'perception of sustainability and its dialectics'.

NON TECHNICAL EVENTS

In addition to technical events, non-technical events were also conducted to engage students from different backgrounds. These events included Neon Football, Face Painting, Fear Chamber, Casino Royale, and Paintball.

Neon Football

This is a 3s football game set within a dark room with neon lightings. The event was conducted on the first day.

Casino Royale

A bunch of small games ensured maximum participation with minimal entry fee.

PaintBall Arena

Participants shooted color bullets with guns wearing all safety measures.

Face Painting

Visitors can do a painting on the body with any design they want.

Fear Chamber

A room setup which was created to experience the horror in real life for the visitors.


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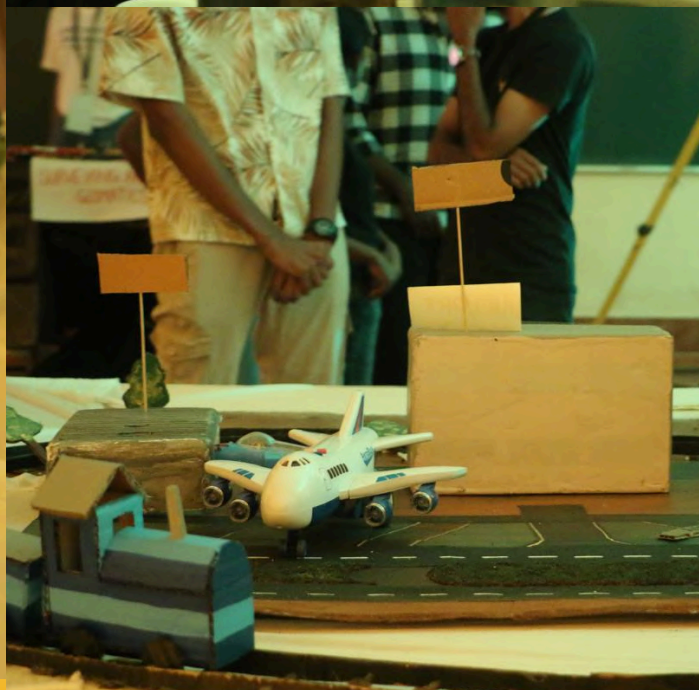


Face
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